REMARKS

Claims 1-27 were pending in the application. Claims 1-27 stand rejected. Claims 13-22 were cancelled. Claims 1, 23-24, and 26-27 were amended. Claims 28-34 were added.

Claim 13 stands objected to because of the incorrect label "(c)" following "(a)". Claim 13 was cancelled.

The rejection of Claims 1-27 is not fully understood. The rejection repeated refers to the imager of Carlson as having a three dimensional shape: "the cylindrical imager" (page 7, line 6) and "the spherical imager" (page 7, line 21). Carlson does not disclose this, nor does use of polar coordinates mandate a three dimensional shape. A definition states:

> "POLAR COORDINATES Any point in a plane can be identified by its distance from the origin (r) and its angle of inclination (Θ)." (*Dictionary of Mathematical Terms*, 2nd ed., D. Downing, Barron's, Hauppauge, New York, (1995), page 247)

Figure 3 of Carlson illustrates the imager as planar.

Claims 1-5, 8, 10, 13-16, 18-20, and 22 stand rejected under 35 U.S.C. 102(b) as being anticipated by Carlson (U.S. Patent No. 4,554,585). The rejection stated in relation to Claim 1:

> "For claim 1, Carlson teaches an electronic imaging system (fig. 1, 100, 110, 108) for capturing an image of a scene (col. 2, lines 57-62), said imaging system comprising:
>
> "(a) an optical system (fig. 1, 100) for producing an optical image of the scene (col. 2, line 63 - col. 3, line 10);
>
> "(b) an imaging sensor (solid-state imager, col. 2, lines 63-65) having a surface in optical communication (col. 2, line 66 - col. 3, line 2) with the optical system; and
>
> "(c) a plurality of imaging elements (fig. 2a) distributed on the surface of the imaging sensor (col. 4, lines 13-23) for converting the optical image into a corresponding output signal (col. 3, lines 4-7), said imaging elements located according to a distribution representable by a nonlinear function in which the relative density of the distributed imaging elements is greater toward the center of the sensor (col. 4, lines 28-33), wherein the distribution provides physical coordinates for each of the imaging elements

corresponding to a projection of the scene onto a non-planar surface, thereby compensating for perspective distortion of the scene onto the non-planar surface (col. 4, lines 24-28)."

Amended Claim 1 states:

1. An electronic imaging system for capturing an image of a scene; said imaging system comprising:

(a) an optical system producing an optical image of the scene;

(b) an imaging sensor having a surface in optical communication with the optical system; and

(c) a plurality of imaging elements distributed on the surface of the imaging sensor, said imaging elements converting the optical image into a corresponding output signal, said imaging elements being located according to a distribution representable by a nonlinear function in which the relative density of the distributed imaging elements is greater toward the center of the sensor, wherein the distribution provides physical coordinates for each of the imaging elements corresponding to a projection of the scene onto a non-planar surface;

wherein said optical image has a perspective distortion relative to said surface and said distribution of said imaging elements on said surface of said imaging sensor compensates for said perspective distortion.

Claim 1 is supported by the application as filed, notably the original claims and at page 9, lines 15-19. Language in (a) and (c) was changed to broaden those provisions.

Claim 1 states that the optical image produced by the optical system has a perspective distortion relative to the surface of the imaging sensor and the distribution of imaging elements on that surface compensates for the perspective distortion of the optical image. This is not disclosed in the cited references.

Carlson discloses an imaging system that is part of a larger control system, such as a robotic system or target tracking system. (Carlson, col. 2, lines 57-60) In Carlson, the optical image is subject to a low-pass prefilter to minimize aliasing. (Carlson, col. 6, lines 1-11; Carlson, in Figure 3, shows an optical prefilter that forms an image on a diffusing surface 310, which is spaced from the imager 300 by transparent material (or air--Carlson, col. 6, lines 25-29)) The imager has picture

elements that increase in size in a direction outward from a center to reduce signal processing requirements. (Carlson, col. 3, lines 56-65) Distortion is not addressed.

Hsieh et al. removes optical perspective distortion by computation. (Hsieh et al. col. 3, line 66 to col. 4, line 39) Ribera et al. discloses use of a spherical lens with a spherical CCD. (Ribera et al., abstract)

Claims 2-5, 8, and 10 are allowable as depending from Claim 1.

Claims 13-16, 18-20, and 22 were cancelled.

Claims 6-7 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson in view of Hsieh et al. Claims 6-7 are allowable as depending from Claim 1.

Claims 9, 17, and 21 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson. Claim 9 is allowable as depending from Claim 1. Claims 17 and 21 were cancelled.

Claims 11-12 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson in view of Ribera et al. The rejection states:

> "For claim 11, Carlson discloses a system with a moveable television camera that produces a video signal, which is coupled to an image signal processor. Carlson's image signal processor, which analyzes the image defined by the video signal to determine the exact whereabouts of a particular object in field of view, can inherently operate directly on the output signal without having to warp the image data (col. 3, lines 33-46). However, Carlson does not teach a system including a processor for combining the images into a composite image.
>
> "In the same field of endeavor, Ribera discloses a system including a processor (Ribera, fig. 4, ref. 10) for combining the images into a composite image, thereby the processor can operate directly on the output signal without having to warp the image data (Ribera, col. 6, lines 10-21 and col. 4, lines 51-55). Similar to Ribera, Carlson's invention is related to wide view images (Carlson, col. 2, line 67 - col. 3, line 1). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system including a processor for combining the images into a composite image, thereby the processor can operate directly on the output signal without having to warp the image data in order to display

panoramic images over a substantially 360 degree by 360 degree range of angles (Ribera, col. 1, lines 36-39)."

Claim 11 states:

> 11. The system of claim 10 further including a processor for combining the images into a composite image, whereby the processor can operate directly on the output signal without having to warp the image data.

Carlson contradicts the motivation argued in the rejection for combining Carlson and Ribera et al. The rejection states:

> "Carlson's invention is related to wide view images (Carlson, col. 2, line 67 - col. 3, line 1). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system including a processor for combining the images into a composite image ..."

Carlson states:

> "In accordance with the principles of the present invention, relatively high spatial resolution is provided solely within the limited extent of the central region 104 of field of view 102. Within those portions of the field of view 102 falling outside of central region 104 only relatively low spatial resolution is provided." (Carlson, col. 3, lines 56-61)

A composite of Carlson's images would have a series of high resolution spots/lines alternating with areas of low resolution. The usefulness of such a composite image is not apparent, particularly in view of the intent of the imaging system of Carlson to be part of a larger control system. (Carlson, col. 2, lines 57-60) Such a composite image would also contradict Carlson's goal of reduced signal processing. (Carlson, col. 3, lines 61-65)

Assuming for the sake of argument that "it would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to implement a system [of Ribera et al.] including a processor for combining the images into a composite image, thereby the processor can operate directly on the output signal without having to warp the image data in order to display panoramic images over a substantially 360 degree by 360 degree range of angles", what would that combination be? As earlier discussed, Carlson does not disclose the use of a cylindrical or spherical imager, nor does Carlson address distortion. Ribera et al. discloses use of a spherical lens with a spherical CCD. A combination of Carlson and

Ribera et al. that would provide the paroramic images of Ribera et al. would apparently also include the spherical lens and spherical CCD of Ribera et al. This is unlike the claimed invention, in which the optical system provides an optical image that has a perspective distortion relative to the surface of the imaging sensor, a distribution of imaging elements on the surface of the imaging sensor that compensates for the perspective distortion, and a processor that operates directly on the output signal without having to warp the image data.

Claim 12 is allowable as depending from Claim 11.

Claims 23-27 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Carlson in view of Huang et al. ("Panoramic Stereo imaging System with Automatic Disparity Warping and Seaming," Graphical Models and image Processing, Vol. 60, No. 3, May 1998, pp. 196-208.) The rejection states:

> "For claim 23, Carlson teaches a method (fig. 1, 100, 110, 108) comprising: (a) generating the source digital images from an imaging source having imaging elements distributed so as to compensate for perspective distortion of the scene onto a non-planar surface (col. 2, lines 63-65; col. 3, lines 4-7 and 47; col. 4, lines 28-33). This claim differs from Carlson in that he does not teach a method of generating a composite digital image from at least two source digital images, said method comprising:
>
> (b) combining the source digital images to form a composite digital image.
>
> In the same field of endeavor, Huang teaches a method of generating a composite digital image from at least two source digital images (page 197, section 3.1, paragraph 1), said method comprising: (b) combining the source digital images to form a composite digital image (page 200, section 3.5). Additionally, Huang's panoramic stereo imaging system inherently has an imaging sensor because his system includes two cameras for the left-eye and the right-eye (page 197, section 3.1, paragraph 2). This system generates focused images by selecting the correctly focused image for each sensor (pages 197-198, section 3.2. paragraphs 1-2). Please see figs. 5-6 and read pages 199-200, section 3.4, paragraphs 1-2. Similar to Huang, Carlson discloses an imaging system for image warping/ blurring improvements (Carlson, Abstract). It would have been obvious to one of ordinary skill in the art at the time the invention was made for Carlson to provide a method of

generating a composite digital image from at least two source digital images in order to provide 360° panoramic stereo images (Huang, section 2, page 197, paragraphs 2-4).

Claim 23 states:

> 23. A method of generating a composite digital image from at least two source optical images having a perspective distortion relative to a planar surface, said method comprising:
>
> (a) generating at least two source digital images corresponding to said optical images, from an image sensor having imaging elements distributed, in a plane, so as to compensate for said perspective distortion; and
>
> (b) combining the source digital images without further correction of said perspective distortion to form a composite digital image.

Claim 23 is supported by the application as filed, notably, the original claims and at page 11, lines 4-9; and page 9, lines 15-19.

Claim 23 requires generating source digital images from an image sensor having imaging elements distributed in a plane. The digital images, which correspond to optical images having a perspective distortion relative to a planar surface, compensate for the perspective distortion. Carlson, as discussed above in relation to Claim 1, does not address distortion.

Claim 23 also requires combining the source digital images without further correction of the perspective distortion to form a composite digital image. As noted earlier in relation to Claim 11, a composite of Carlson's images would have a series of high resolution spots/lines alternating with areas of low resolution. What would motivate one of skill in art to make such a composite image? Also note, as earlier discussed, Carlson's goal of reduced signal processing (Carlson, col. 3, lines 61-65) and the intent of the imaging system of Carlson to be part of a larger control system (Carlson, col. 2, lines 57-60), both of which would motive one of skill in the art to not combine Carlson with Huang.

The rejection of Claim 23 also states:

> "Similar to Huang, Carlson discloses an imaging system for image warping/ blurring improvements (Carlson, Abstract)."

This sentence is not understood. Carlson does not disclose image warping. If the phrase "image warping/ blurring improvements" equates image warping and blurring, then the phrase is meaningless. This approach would equate all dissimilar image

processing techniques and, thus, eliminate motivation for the cited combination. How would one of skill in the art choose any particular combination of references over all of the other possible combinations?

Claims 24-27 are allowable as depending from Claim 23. Claim 24 was broadened. Claims 26-27 were amended in accordance with the changes in Claim 23.

Added Claims 28-31 and 33 are supported and allowable on the grounds discussed above in relation to Claim 1. Claims 32 and 34 are allowable as depending from Claims 31 and 33, respectively, and are supported and allowable on the grounds discussed above in relation to Claim 11.

It is believed that these changes now make the claims clear and definite and, if there are any problems with these changes, Applicants' attorney would appreciate a telephone call.

In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

Respectfully submitted,

Attorney for Applicant(s)
Registration No. 30,700

Robert Luke Walker/amb
Rochester, NY 14650
Telephone: (585) 588-2739
Facsimile: (585) 477-1148